New York.—The mean temperature was 52.0°, or 2.8° above normal; the highest was 90°, at Auburn on the 1st, and the lowest, 18°, at Bolivar and Franklinville on the 18th. The average precipitation was 4.92, or 1.50 above normal; the greatest monthly amount, 8.94, occurred at Easton, and the least, 2.75 at Madison Barracks.—*R. G. Allen.*

North Carolina.—The mean temperature was 60.3°, or 0.8 above normal; the highest was 90° at Fayetteville on the 3d and at Rockingham on the 4th, and the lowest, 21°, at Highlands on the 27th. The average precipitation was 6.42, or 2.85 above normal; the greatest monthly amount, 18.49, occurred at Linnville, and the least, 2.26, at Lumberton.—*C. F. von Herrmann.*

North Dakota.—The mean temperature was 38.6°, or 3.8° below normal; the highest was 84°, at Ashley and Forman on the 1st, and the lowest, 8°, at Fort Yates on the 25th. The average precipitation was 2.37, or 1.41 above normal; the greatest monthly amount, 6.20, occurred at Milton, and the least, 0.30, at Glenullin.—*B. H. Bronson.*

Ohio.—The mean temperature was 54.1°, or about 2.0° above normal; the highest was 96°, at Milligan on the 4th, and the lowest, 20°, at Cambridge and Levering on the 28th. The average precipitation was 3.72, or 1 68 above normal; the greatest monthly amount, 7.87, occurred at Elyria, and the least, 1.76, at Hedges.—*J. Warren Smith.*

Oklahoma.—The mean temperature was 60.1°; the highest was 110°, at Waukomis on the 2d, and the lowest, 21°, at Fort Reno on the 22d, at Anadarko and Wagoner on the 26th, and at Norman on the 30th. The average precipitation was 1.97; the greatest monthly amount, 5.38, occurred at Wagoner, and the least, 0.48, at Anadarko.—*J. I. Widmeyer.*

Oregon.—The mean temperature was 49.5°, or 1.6° below normal; the highest was 84°, at Langlois on the 16th, and the lowest, 11°, at Burns on the 3d. The average precipitation was 2.01, or 1.06 below normal; the greatest monthly amount, 8.51, occurred at Bay City, and the least, trace, at Burns.—*B. S. Pague.*

Pennsylvania.—The mean temperature was 53.8°, or 3.7° above normal; the highest was 92°, at Derry Station on the 4th, and the lowest, 20°, at Hollidaysburg, Shinglehouse, Smethport, and Somerset on the 28th. The average precipitation was 5.20, or 1.96 above normal; the greatest monthly amount, 8.62, occurred at Wellsboro, and the least, 2.36, at Wilkesbarre.—*T. F. Townsend.*

South Dakota.—The mean temperature was 42.7°, or about 4.0° below normal; the highest was 88°, at Chamberlain, Hotch City, and Pierre on the 1st, and the lowest, 2° below zero, at Rochford on the 25th. The average precipitation was 1.28, or about normal; the greatest monthly amount, 4.20, occurred at Flandreau, while none fell at Forest City.—*S. W. Glenn.*

Tennessee.—The mean temperature was 57.6°, or about normal; the highest was 93°, at Pope on the 5th and at Covington on the 6th, and the lowest, 20°, at Erasmus on the 28th. The average precipitation was 4.34, or about 2.00 above normal; the greatest monthly amount, 8.80, occurred at Oakhill, and the least, 0.98, at Covington.—*H. C. Bate.*

Texas.—The mean temperature, determined by comparison of 36 stations distributed throughout the State, was 1.0° below the normal. The temperature was about the normal over the panhandle, and there was a slight deficiency over the western portions of the State and a general deficiency, ranging from about 1.0 to 3.0 over the eastern portions, with the greatest deficit in the vicinity of Tyler. The highest was 104°, at Fort McIntosh on the 1st and at Lampasas on the 2d, and the lowest, 23°, at Mount Blanco on the 26th. The average precipitation, determined by comparison of 37 stations distributed throughout the State, was 0.89 below the normal. There was a slight excess in a few localities over the central portion of the State, while there was a general deficiency elsewhere, ranging from 1.00 to 3.39, with the greatest deficit along the east coast. The greatest monthly amount, 6.60, occurred at Huntsville, while none fell at several stations.—*I. M. Cline.*

Utah.—The mean temperature was 47.0°; the highest was 90° at St. George on the 12th, and the lowest, 3°, at Loa on the 22d. The average precipitation was 0.67; the greatest monthly amount, 2.40, occurred at Tooele, while none fell at several stations.—*J. H. Smith.*

Virginia.—The mean temperature was 58.4°, or about 1.0° above normal; the highest was 90°, at Farmville on the 4th, and the lowest, 21°, at Blacksburg on the 28th. The average precipitation was 6.21, or 3.04 above normal; the greatest monthly amount, 12.01, occurred at Stanardsville, and the least, 2.52, at Warsaw.—*E. A. Evans.*

Washington.—The mean temperature was 49.1°, or about 1.0° below normal; the highest was 79°, at Kennewick on the 14th, and the lowest, 11°, at Waterville on the 16th. The average precipitation was 2.79, or about normal; the greatest monthly amount, 11.01, occurred at Clearwater, and the least, trace, at Fort Simcoe and Waterville—*G. N. Salisbury.*

Wisconsin.—The mean temperature was 45.2°, or 1.3° below normal; the highest was 82°, at Grantsburg on the 2d, and the lowest, 9°, at Hartford City on the 27th. The average precipitation was 4.01, or 1.82 above normal; the greatest monthly amount, 5.80, occurred at Whitehall, and the least, 1.34, at North Crandon.—*W. M. Wilson.*

Wyoming.—The mean temperature was 39.7°; the highest was 82°, at Fort Laramie on the 1st, and the lowest, 4°, at Labarge on the 20th. The average precipitation was 0.96; the greatest monthly amount, 2.25, occurred at Fort Yellowstone, and the least, 0.10, at Bigpiney.—*W. S. Palmer.*

SPECIAL CONTRIBUTIONS.

A RECORD OF SOME KITE EXPERIMENTS.

By WILLIAM A. EDDY, Bayonne, N. J. (dated December 5, 1898).

My first experiment with a kite was in 1863, when with another boy I tied a lantern to the tail of an ordinary kite at night. The lantern was soon extinguished by the rapid motion of the kite tail, but it did not occur to me to suspend the lantern from the string below the kite. In 1887 I heard of the life-saving use of the kite for towing buoys ashore, invented by J. Woodbridge Davis, of New York, and while looking up the subject, I read an account of the experiments of E. Douglas Archibald, of England, published in Nature, in 1886. In a copy of the Pall Mall Gazette sent to me in 1896 or 1897 from London, Archibald is recorded as having taken a kite photograph in 1886. I am yet without knowledge of Archibald's method of suspending his camera, but one of his kite photographs which I saw at Blue Hill Observatory when I first flew my kite there on July 30, 1894, revealed the fact that his camera pointed straight downward. The view was dated 1888. In the London article mentioning Archibald's kite-photograph, M. Batut, of France, is credited with a kite-photograph in the same year. Wenz, of Paris, seems to have taken up the subject of kite-photography in 1890 or 1891. He has recently sent to me, care of Blue Hill Observatory, a clear kite-photograph, not titled, but evidently of the Seine in Paris, for which I shall send him two of my own of the Capitol at Washington, one taken by hand from the roof of the Coast Survey Building, and the other with the camera suspended from the kite cable about 300 feet above the roof. The European kite photographers seem to have taken map views, leaving the writer to take his first perspective view from kites on May 30, 1895, at Bayonne, N. J.[1]

In 1890 I began with tail kites of the ordinary pattern and

[1] To this catalogue of dates of kite work the Editor may add that in the spring of 1885, at the conclusion of a series of balloon ascensions for meteorological purposes made for the Army Signal Service by Prof. S. A. King, of Philadelphia, an additional ascent was made for special military purposes. Photographic apparatus was carried, and pictures taken from the balloon, although not very successfully. Mr. Eddy states that some striking photographs were taken at Winsted, Conn., about 1885, by an aeronaut whose name is unknown.

As Professor King has devoted his life to the practical utilization of the balloon in every imaginable way, it will be interesting to add the following extract from a recent letter from him:

"In my scrap book I find a print of my first photographic experiment. * * * It was during the month of August in 1860. The attempt was made at Providence, R. I., and Mr. J. W. Black, of Boston, was the photographer. In October following, Mr. Black and myself ascended from Boston and succeeded in obtaining two fine views of the central portion of the city, each view containing features of historic interest. An article in the Boston Herald referring to the experiment is dated October 16, 1860, and mentions it as taking place on the previous Saturday. On the 4th of July, 1893, Mr. W. N. Jennings accompanied me with photographic apparatus and succeeded in obtaining the three views of Philadelphia which have been widely distributed and are, undoubtedly, the best views ever taken from a balloon."

Copies of these magnificent photographs are at the Weather Bureau; they were evidently taken instantaneously with a very superior lens, and give perspective views, as distinguished from the vertical projections or map views. Photographic views from balloons for military purposes were taken during the war of 1861-65, but we do not know that any special benefits resulted.—ED.

soon found that the sag of the kite cable was a serious obstacle to altitude in raising a self-recording thermometer, in which I have since found that I was preceded by Wilson and Melville, 1749, and by Kew Observatory later. In 1883–4 Archibald had, as I gathered from the account in Nature, attached the line of the upper kite to the back of the kite below it, and had thus made a chain of two kites in tandem. I at once tried a different method, and, on May 9, 1891, reached an estimated altitude of about 4,000 feet with 5 hexagon tail kites, each kite moving freely with its individual line lifting the sag of the main line. I had, previously, on February 4, 1891, made my first self-recording thermometer ascension, using a Hicks U thermometer suspended from the kite cable as detailed in the American Meteorological Journal, July, 1891, when I began to experiment with tailless kites. On November 7, 1893, after having reached great heights in 1892, I passed my first triangulated mile of altitude, using 9 tailless kites from 2½ to 6 feet in diameter. Had I used the same diameter of line all the way to the top, the weight of the line might have broken it, aside from wind pressure, but I used at the top strong and very thin thread, with small kites exerting a light pull. This caused the maximum pull at the earth to be only 18 pounds. In hauling in this line about 9, p. m., the top line, with 2 kites, was swept away, and probably disappeared in Newark Bay. The wind velocity at the New York Weather Bureau station was 8 to 12 miles per hour from the east.

I have so far taken about 400 kite photographs, nearly all of which are perspective views. Following are dates of my first mid-air photographs from kites in different localities for purposes of permanent record:

Bayonne, N. J., May 30, 1895; Blue Hill Observatory, August 20, 1895; New York, September 25, 1895; Portland, Me., August 19, 1896; Boston, Mass., August 25, 1896; Elmont, L. I., September 7, 1896; Philadelphia, Pa., May 15, 1897; first simultaneous mid-air photographs from two cameras at New York June 5, 1897; State Camp, Peekskill, N. Y., June 20, 1897; State Camp, Sea Girt, N. J., July 25, 1897; Washington, D. C., September 8, 1897; Reading Pa., June 8, 1898; Statue of Liberty, New York Harbor, October 27, 1898.

As to experiments on atmospheric electricity with kites, my first spark was drawn from copper wire, festooned to the kite cable, at Bayonne, N. J., October 8, 1892, followed by a large number of spark observations since that date. I found by measurement that the altitude of the collector when the first spark was drawn was closely related to the humidity of the air, and I drew curves showing the altitude of the collector as related to surface humidity at the earth, using wet and dry bulb thermometers with the Weather Bureau tables. In dry air I had to send the collector to a height of at least 600 feet before an appreciable spark resulted. The electric action can be traced with considerable certainty, because the frequency of the spark as related to the spark gap exactly corresponds to the electric intensity aloft. There is a relation between this spark frequency and the approach of clouds and local storms, especially as related to the formation of rain, which I hope to discover before long. My first indoor electric spark or flash of light through an incandescent globe from the kite wire occurred at 6:42 p. m., November 27, 1896. The spark was strengthened by two Leyden jars and by glass cylinders coated with tin foil, and by insulated coils of wire wound around soft iron. McAdie lighted an incandescent globe during a thunderstorm by kite wire in 1885 or 1892 at Blue Hill Observatory, but mine differed in that the carbon filament of the incandescent globe was broken before trial, on purpose, causing the kite wire spark to leap across a space in the vacuum.

On November 1, 1898, under a clear sky, I sent an electric collector into the air within about 100 feet of the Statue of Liberty, New York harbor. The first spark was drawn at 11:15 a. m. with the collector about 200 feet above the surface of Liberty Island, and about 100 feet below the top of the torch of the statue. When I carried the kite wire, supported by 3 paper kites 6 feet in diameter, to within about 30 feet of the statue, an immense mass of bronze, the electric action vanished. Other experiments on November 1, 3, and 4, proved that the statue did not appreciably affect the air in this respect beyond a distance of 100 feet from its surface. Upon carrying the wire within 70 feet the electric action almost ceased. I hope to define more closely this electric influence later by triangulating distances and timing the sparks.

On August 4, 1894, I used several of my kites to raise a meteorograph at Blue Hill Observatory. A Richard thermograph, giving also barometric pressure, had been remodeled by Fergusson at the expense of the observatory, and was lightened by the use of aluminum. Messrs. Clayton and Fergusson gave me every possible assistance. Mr. Rotch was then in Europe, but Mr. Clayton had previously granted me permission to try the first kite meteorological experiments there, which were conducted entirely at my own expense. This meteorograph, the first one in the world ever lifted by kites, reached a height of 1,400 feet, and it brought back to the earth, at times, an admirably clear record.

The Fergusson meteorograph just alluded to had carried out my suggestion of January 2, 1894, as published on page 483, Vol. X of the American Meteorological Journal, entitled "Weather map data at the height of 5,000 feet," in which I say:

> It is clear that light meteorological instruments can be raised to a height of 5,000 feet by means of improved, tailless Malay kites. * * * An aneroid barometer, an U-shaped Hicks thermometer and an anemometer, all self-recording, can be so made that their combined weight shall not exceed *one pound.*[1]

I brought my kites to the Blue Hill Observatory, and the meteorograph was ready for use shortly after my arrival, when I at once made the ascension of August 4 described in the previous paragraph.

The first kite telephone message, as pointed out by Fergusson in MONTHLY WEATHER REVIEW, August, 1898, p. 366, with the kite wire extending over houses and trees, was successfully received by me at Bayonne, N. J., on December 5, 1896, the voices being heard clearly. Mr. H. C. Bradley, of the Lighthouse Service, near Boston, had suggested to me at Blue Hill Observatory in 1894, the possibility of listening to the sounds of the upper air by means of a telephone sent aloft. This would be of use in studying the audibility of fog signals. I tried this experiment late in December, 1896, but I could not hear, owing to a defective megaphone receiver and the roar of the wind against both the megaphone and kite cable, but I have improvements under way which may enable me to succeed soon.

My first rain kite reached a height of 591 feet on November 4, 1893, and remained aloft from 2 to 5 p. m., while the wind velocity at the New York Weather Bureau station was from 18 to 20 miles per hour. On August 18, 1896, a self-recording thermometer aloft passed through a heavy shower at Portland, Maine, the kites remaining aloft, and subsequently drying in the air. The fall of temperature was from 71° to 61°.

My first aerial camera obscura, which I named the vistascope, ascended to a height of about 300 feet on the kite cable on August 15, 1897, when the sails of moving yachts and the roofs and sides of distant houses were visible to those lying on the ground and looking upward with a powerful field glass into the dark cavity of the camera obscura. On November 12, 1897, my first crossbow aeroplane was shot from the kite

[1] In 1893, at the Columbian Exposition, I found that the title "Malay" was incorrect as applied to my form of kite, but I did not try to correct this usage until several years later.

cable aloft, landing more than 1,000 feet away. It was fired at night, but a burning saltpeter fuse, attached to the arrowhead, traced its path in the darkness.

My first use of kites of specific size with which to measure the wind velocity by means of a pull on a spring balance, as compared with the record of the anemometer at a similar height at the New York Weather Bureau station was made early in 1894, but was elaborated with many classified observations on December 18, 1897.

My first self-illumined, single plane kite ascended March 26, 1898, with the lighted lantern within six inches of the surface of the kite. My first simultaneous kite temperatures were taken at New York and Bayonne, N. J., April 9, 1898. Mr. Henry L. Allen operated the kites at Bayonne and I operated those in New York. (See MONTHLY WEATHER REVIEW, April 1898, p. 161.) The United States flag was first brilliantly illuminated by colored fire, also suspended in mid-air near the flag on April 30, 1898. My first dynamite messenger war kite ascended under wind pressure on April 2, 1898, and the first shooting-star war signal lantern was released at a height of about 900 feet, and descended by gravity down the kite cable at 8 p. m., June 17, 1898.

Prof. S. P. Langley, in March or April, 1894, sent me a grant from the Hodgkins fund for the purpose of experiment with silk cord in reaching a great altitude with kites. My experiments with silk cord, which extended over more than a year, demonstrated that while silk was very strong for its weight, about twice as strong for its weight as compared with steel, as demonstrated by Professor Thurston, of Cornell University, yet its tensile strength was too unequal owing to fraying or attrition of its surface, and in my report to the Smithsonian Institution I recommended the use of flax with a steam engine for winding in the kite cable. The steam engine at Blue Hill Observatory was established by cooperation with the Hodgkins fund, steel wire being used, that standing next to silk in tensile strength, as related to its weight. Steel wire was used as kite cable by Archibald in 1884, as described in Nature, in 1886.

Since about five miles of wire were run out at Blue Hill Observatory to reach 11,494 feet above the summit of the hill on August 26, 1898, with 149 square feet of kite surface, it seems to me that at great heights the increasing wind velocity with height may not quite compensate for loss of pressure due to rarefaction of the air. Important estimates remain to be made in this direction.

On July 28, 1898, by telegraphic orders from Gen. A. W. Greeley, I sent 26 of my kites and other apparatus to Newport News, Va., to demonstrate in Puerto Rico, experimentally, the value of kites for photographing the enemy's fortifications. The report of Col. W. A. Glassford, who has charge of the apparatus, has not yet reached me. I have, however, heard indirectly that my kites have been successfully used for military flag signaling in Puerto Rico.

THE EFFECT OF PROXIMITY TO THE SEA ON THUNDERSTORM PERIODS.

By HERMAN D. STEARNS, Associate Professor of Physics, Leland Stanford, Jr., University, Palo Alto, Cal.

In a paper on "Thunderstorms and unstable equilibrium in the atmosphere" (Meteorologische Zeitschrift, April, 1895), Prof. Wilhelm von Bezold has given a number of reasons for expecting a difference in the daily and yearly thunderstorm periods when inland observations are compared with those made on or near the sea.

Von Bezold accepts Mohn's division of thunderstorms into the two classes: Heat and cyclonic thunderstorms. The heat thunderstorms are regarded as due to the breaking up of a condition of unstable equilibrium in the atmosphere; the resulting rapidly ascending current forms the necessary thunderstorm condition. The cyclonic thunderstorms accompany the general cyclonic storms and find their condition in the ascending current at the center of the cyclone.

Three causes for unstable equilibrium in the atmosphere are cited: (*a*) overheating of the lower layers of the atmosphere, first mentioned by Reye; (*b*) overcooling of the higher atmospheric layers, first pointed out by Prof. W. M. Davis; (*c*) a sudden change of state in the atmosphere, such as a sudden condensation of water vapor or a sudden freezing of suspended water.

The overheating of the earth's surface on hot, still summer afternoons accounts for the well-marked summer afternoon maximum shown by inland observations. The wind and the cooling influence of the water prevent so marked a summer afternoon maximum on the sea.

Unstable equilibrium due to overcooling of upper atmospheric layers is not so easily accounted for, because the necessary condition for rapid cooling would seem to be either wind or cloud, the wind to introduce cold air from other regions, the cloud to produce cooling by rapid radiation from its upper surface. But the wind itself would prevent a condition of unstable equilibrium, and a cloud is usually caused by the ascending current of a cyclone, which would likewise prevent an unstable condition. The cooling due to the cloud would, however, cause an increased velocity in the ascending cyclonic current, and hence would increase the probability of a cyclonic thunderstorm. This phenomenon would be most frequent in the case of the low-hanging clouds over the moist air above the sea and the coast on winter nights. The result would be an increase in the number of winter-night cyclonic thunderstorms on the sea and the coast.

The so-called supersaturation of the atmosphere with water vapor would (if this phenomenon takes place in the free atmosphere) be more probable on the sea than inland, because of the greater probability of the presence of dustless air, and would be most likely to occur over the tropical sea, with its great evaporation. The sudden condensation of this vapor, accompanied by the resulting ascending current, would make a thunderstorm probable.

Unstable equilibrium due to the overcooling of water suspended in clouds and the thunderstorms likely to occur on the sudden freezing of this water are evidently as probable on the sea as on the land, and would generally be winter-night phenomena.

Hence, Professor von Bezold concludes that winter and night thunderstorms, compared with summer and afternoon thunderstorms, should be much more frequent on the sea and the coast than inland, but that this effect can scarcely be expected in the case of seacoasts where the paths of the cyclones are generally from the land to the sea, as is usually the case on east coasts in our latitude.

The work of Messrs. Mohn and Hildebrandson on Norway and Sweden and of Dr. Meinardus on the open sea show a general agreement with the above theory, as do, also, other more or less complete reports for different places.

At the suggestion of Professor von Bezold, who permitted me to use the excellent library of the Meteorological Institute at Berlin, and who, with his associates, showed me every kindness, I have tried to add something to the work already published. My work has been confined almost entirely to the yearly period of thunderstorms, and the results appear in the tables below. The tables are followed by the curves showing graphically the monthly percentages in such cases as afford a basis for comparison.

ICELAND.—COAST STATIONS.

The material is taken from the yearly Danish reports. The observations for one station in August, 1893, are wanting.